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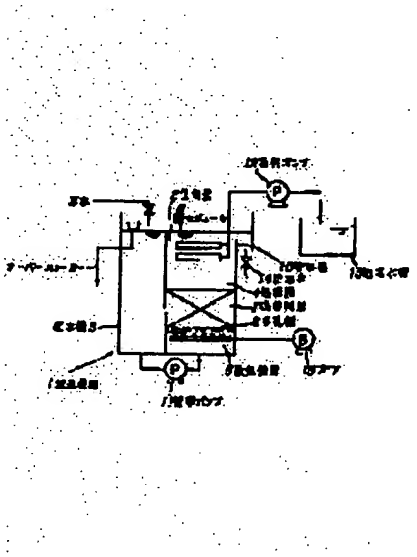
(54) MEMBRANE FILTER

(57)Abstract:
PURPOSE: To simplify equipment by performing both the clarification with a membrane filter equipped with a membrane module and the removal of soluble materials with an adsorber in the same equipment.
CONSTITUTION: In the lower part of a membrane filter 1 equipped with an outer pressure type membrane module 8, is installed an adsorbing layer 7 using a granular adsorbent for adsorbing soluble materials dissolved in raw water to simultaneously remove both suspended and soluble materials.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] Membrane filtration equipment characterized by preparing the adsorption layer which used the granular adsorption material which adsorbs the dissolved solids which are dissolving in the lower part of the membrane filtration facility with which the external pressure mold membrane module is arranged into raw water, and removing a suspended solid and dissolved solids to coincidence.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the membrane filtration equipment for filtering the suspended solid contained in raw water, such as river water, lake water, nightsoil, sewage, service water, and waste water.
[0002]
[Description of the Prior Art] In the target raw water, many the algae and bacteria (active sludge etc.) which are easy to produce slime in a filter in addition to the inorganic substance which is easy to remove by filtration as an SS are contained. Moreover, dissolved solids other than the above-mentioned matter, such as odor and tastes, such as a chromaticity, manganese, and a musty odor, a trihalomethane precursor, and the minute amount organic substance, are contained. In order to process these raw water, methods, such as [coagulation sedimentation -> filtration] and [pressurization surfacing -> filtration], perform for SS removal a current general one, and it is processed by the activated-carbon-treatment method etc. apart from the process of SS removal to dissolved solids.
[0003] As compared with the above-mentioned conventional SS removal mode of processing, SS removal mode of processing by membrane filtration equipment has the very good water quality of treated water other than 1 dissolved solids.
2) It may be able to carry out by non-dosing.
3) An advance of a future film technique can be desired.
There is ********** and the ED of utilization is everything line crack ******. However, in a micro filter and ultrafiltration membrane, removal of dissolved solids is difficult. Therefore, even when carrying out removal processing of the SS using a film processor, for removal of dissolved solids, separate facilities, such as activated carbon treatment, are needed.
[0004] Therefore, in the present condition, a micro filter or ultrafiltration membrane is used, and in order to perform removal of insolubility and dissolved solids, it becomes a process as shown in drawing 3 . Although granular active carbon is common as an adsorption facility in drawing because of removal of dissolved solids, manganese sand is needed for removal of dissolution manganese. Moreover, at the present process, cleaning equipment is needed for a film processor and an adsorption facility, respectively.
[0005] Circulation layer equipment is indicated by JP,2-75304,A for removal of dissolved solids. This equipment is an outstanding processor from which dissolved solids are removed, circulating through raw water and the mixture of granular adsorption material at a rate quicker than the settling velocity of granular adsorption material, circulating through the granular adsorption material with raw water using granular adsorption material. The above-mentioned circulation layer equipment cannot perform removal of a non-melt. However, this equipment has the description that less deposition in the granular adsorption material layer of a suspended solid is than the case of a fixed adsorption layer, even if raw water contains SS component, since it circulates through raw water and the granular adsorption material layer is used as the fluid bed.
[0006]
[Problem(s) to be Solved by the Invention] The technical problem of this invention removes the turbidity reduction by the membrane filtration facility with which the membrane module is arranged, and the dissolved solids by adsorption facility within the same equipment, and is to simplify a facility.
[0007]
[Means for Solving the Problem] The above-mentioned technical problem is attained by the membrane filtration equipment characterized by preparing the adsorption layer which used the granular adsorption material which adsorbs the dissolved solids which are dissolving in the lower part of the membrane filtration facility with which the external pressure mold membrane module is arranged into raw water, and removing a suspended solid and dissolved solids to coincidence.
[0008] In order that the main point of this invention may remove a suspended solid and dissolved solids to coincidence within ** same equipment, the raw water which fills up the lower part of a processor with adsorption material as a granular object, and is used as a packed bed lets water flow as an upper counterflow.
** In order to let the raw water containing a suspended solid flow, in order that granular adsorption material may cause lock out with a suspended solid, let a granular adsorption material layer be the fluid bed by the fixed bed. Adsorption treatment of the dissolved solids is carried out in this granular adsorption material layer.
** A suspended solid removes the suspended solid which it is made to pass the fluid bed of granular adsorption material, and was passed with the membrane module installed in the upper part of a granular adsorption material layer by filtration.
** Perform washing of granular adsorption material and a membrane module to coincidence within the same equipment. It is especially.
[0009] As adsorption material, well-known things, such as powdered active carbon and manganese sand, can be used. Moreover, depending on the quality of a processing object, mixed use of two or more adsorption material may be carried out.
[0010] An organic film or the ceramic film is sufficient as the quality of the material of the film used for an external pressure type membrane module, and the film is classified according to the grain size of the suspended solid by which fractionation is carried out in the case of filtration with the usual filtration membrane, a micro filter, or ultrafiltration membrane. In the usual filtration membrane, a micro filter sets a particle 1 micrometers or more as the object of filtration of a 0.01-several micrometers particle. Moreover, let ultrafiltration membrane be the object of filtration of a very detailed colloidal particle or the amount molecule of macromolecules.
[0011] Amount of water required in order to make a granular adsorption material layer into the fluid bed, and the amount of water of a membrane process become non-equilibrium (amount of water required for making granular adsorption material usually fluidize is larger than film quantity of water to be treated). For this reason, it is a useful means to circulate the fluidization duty of water within equipment, in order to remove a suspended

solid and dissolved solids to coincidence within the same equipment. As an approach of circulating this raw water in equipment, many approaches, such as other stirring of the water supply with a pump, can take.

[0012] Circulating raw water within a processor increases contact time with the adsorption material of raw water besides for making a granular adsorption material layer into the fluid bed, and it is useful also to making the removal effectiveness of dissolved solids increase.

[0013] Also in the granular adsorption material made to fluidize, since there is deposition of a certain amount of suspended solid, a suspended solid is eliminated from adsorption material by the air wash. The air used for washing of adsorption material goes up, and is used for washing of the membrane module installed in the upper part of a processor. That is, by circulating raw water, adsorption treatment of the dissolved solids is carried out to fluidized adsorption material, turbidity reduction of a part of the raw water is carried out with a membrane module, and treated water is obtained.

[0014] Moreover, it is also effective to utilize the circulation layer equipment of a removing-dissolved solids of publication sake for above-mentioned JP,2-75304,A. Circulation layer equipment given in JP,2-75304,A A processing tub is divided into the upward flow section and the downward flow section of raw water with the diaphragm formed in the center. Fill up the downward flow section with granular adsorption material, and raw water is supplied to equipment from under the upward flow section. It has prevented that it is made to circulate in equipment, fluidize a granular adsorption material packed bed, form a guide plate in the upper part of the upward flow section, prepare the separation section above the downward flow section, promote separation of granular adsorption material, and granular adsorption material flows into the equipment upper part with treated water over a guide plate.

[0015] Since deposition in the granular adsorption material layer of the suspended solid contained in raw water is prevented by fluidization of granular adsorption material and separation in the downward flow section of granular adsorption material and guidance are effectively performed with this circulation layer equipment It becomes possible to remove a suspended solid and dissolved solids to coincidence within the same equipment by arranging an external pressure mold membrane module upwards at the pan of the guide plate of the upper part of the upflow section, and removing efficiently the suspended solid in the raw water which has gone up with the membrane module.

[0016] In addition, the membrane filtration equipment of this invention can be used also for the sewage disposal by the activated sludge process, it can use instead of being the settling basin of an activated-sludge-treatment process, or active sludge can be made to be able to exist in a lauter tub, or makes biological slime adhere to adsorption material, and can also calculate the increase in efficiency of activated sludge treatment.

[0017]

[Example] The example of the membrane filtration equipment of this invention is shown in drawing 1 . This example does not explain this invention concretely and this invention is not limited to this.

[0018] (Example 1) The filter 1 is divided into the raw water tub 3 and the processing tub 4 by the bridgewall 2. The diffuser 5 for air washes is installed in the bottom of the processing tub 4, and the perforated plate 6 for supporting granular adsorption material is installed in the upper part. Although the diffuser 5 was installed in the lower part of a perforated plate 6 here, the interior of the granular adsorption material layer 7 is sufficient. The external pressure type membrane module 8 (usually plurality [Although one is sufficient]) is installed in the upper part of the granular adsorption material layer 7. In addition, the wastewater weir 10 is established in overflow 9 in a location higher than a bridgewall 2 lower than a bridgewall 2 in the location higher than the external pressure type membrane module 8 to a filter 1. It can be open for free passage for piping, and the lower part of the raw water tub 3 and the lower part of the processing tub 4 can install a circulating pump 11 in the middle of piping, and can circulate now through raw water to both tubs.

[0019] Operation of membrane filtration equipment 1 flows raw water into the raw water tub 3 of a filter 1 by pump feeding or gravity flow first. Start a circulating pump 11 and flow raw water into the lower part of the raw water tub 3 to the processing tub 4, and become an upper counterflow, the granular adsorption material of the granular adsorption material layer 7 is made to fluidize, and the raw water by which adsorption treatment was carried out returns to the raw water tub 3 over a diaphragm 2. In this way, raw water will circulate through the raw water tub 3 and the processing tub 4 during circulating-pump 11 operation.

[0020] By starting the suction pump 12 connected to the external pressure type membrane module 8 for piping, some raw water through which it circulates is removed by the film in a suspended solid, and it flows into the treated water tub 13 as treated water. Usually, it is made for the balance of the raw water within a filter 1 not to collapse by adjusting raw water inflow according to film quality of water to be treated. The amount of circulation raw water between the raw water tub 3 and the processing tub 4 is carried out to more than a complement making granular adsorption material fluidize. When quantity of water to be treated by the film is made similarly to the amount of raw water required for making it fluidize, processing without circulating is also possible.

[0021] When washing of the granular adsorption material layer 7 and the external pressure type membrane module 8 is the need, washing air is sent by Blois 15 connected to the diffuser 5 for piping, and it washes. At this time, a drain valve 14 is made open for ******** on the lower stream of a river of the wastewater weir 10, and it is desirable that the suction pump 12 for membrane module 8 stops. The opening of a drain valve 14 is adjusted in the amount in which a displacement matches the raw water amount of supply.

[0022] The air by which aeration was carried out from the diffuser 5 discharges the suspended solid detained by the granular adsorption material layer 7 currently fluidized in the upper part of the granular adsorption material layer 7, and also performs the air wash of the membrane module 8 which is on the granular adsorption material layer 7 further. Washing wastewater crosses the washing wastewater weir 10, and is drained from a drain valve 14. Although a membrane module 8 is usually performed in an air wash as above-mentioned, treated water washing etc. may be added.

[0023] (Example 2) Although the membrane filtration equipment of an example 1 is equipment which prepared the granular adsorption material layer currently fluidized in the lower part of a membrane module, the circulation layer equipment for removal of the dissolved solids indicated by JP,2-75304,A described above instead of this granular adsorption material layer currently fluidized can use it effectively.

[0024] Drawing 2 is used and explained below by making into an example 2 the membrane filtration equipment which installed circulation layer equipment in the lower part of a membrane module. This membrane filtration equipment 20 consists of an external pressure type membrane module 22 installed in circulation layer equipment 21 and its upper part in drawing 2 .

[0025] Circulation layer equipment 21 is divided into the raw water descent section 30 and the raw water rising limb 31 with which the granular adsorption material 25 is filled up by the diaphragm 29. Raw water is supplied from the raw water feed zone 24 of the bottom of equipment 20, and goes up the raw water rising limb 31. The granular adsorption material 25 with which the raw water descent section 30 was filled up is supplied to the optimum dose [every] raw water rising limb 31 from this lower part of the diaphragm 29 which cuts and lacks the lower part, with raw water, serves as a disturbance style, goes up, and is adsorbed by the granular adsorption material 25 in the soluble component in raw water by the middle.

[0026] The granular adsorption material 25 which went up with raw water collides with the guide plate 32 in the upper part of the raw water rising limb 31, moves in the direction of the raw water descent section 30, and is deposited on the packed bed of the granular adsorption material 25. Raw water is carried to the filtration section 23 of the upper part of a guide plate 32, after the part has contained the suspended solid. Suction filtration is

carried out with a suction pump 26 with the external pressure type membrane module 22 installed in this filtration section 23, a suspended solid is removed from raw water, and water is supplied to the filtered treated water by the treated water tub 33.

[0027] Although the suspended solid contained in raw water deposits some in the packed bed of the granular adsorption material 25, it exfoliates, in case it becomes a disturbance style and goes up with raw water by the raw water rising limb 31. On the other hand, it is necessary to wash the external pressure type membrane module 22 periodically. There are various well-known approaches, such as an approach of making the deposit of a suspended solid exfoliating by vibration of the film by aeration as a membranous washing method, a method of vibrating the direct film and making a deposit exfoliate from the exterior, and the approach of letting flow from a membranous inside to external surface with treated water, and washing, and you may wash by which approach.

[0028] The example of the cleaning method by the diffuser is shown in drawing 2 . At the time of washing, Blois 27 is started, aeration is carried out with a diffuser 28, a membrane module 22 is washed by the air bubbles going up, and a deposit exfoliates. As an approach of discharging washing wastewater out of a tub, the suction pump 26 of the external pressure type membrane module 22 is suspended, or the amount of suction is decreased, and from quantity of water to be treated, the raw water amount of supply is made [many], and the **** carries out overflow of the wastewater weir 34, and flows out out of a system as washing wastewater. It is also possible to make [many] the raw water amount of supply, and to discharge washing wastewater out of a tub.

[0029]

[Effect of the Invention] Removal of the suspended solid and dissolved solids which are contained in raw water can carry out within the same equipment, and since washing is also possible, a facility becomes simple, and since the installation area is also reduced, an installation cost, operation expense, administrative expenses, etc. can mitigate this invention sharply.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing 1 is the mimetic diagram of one example of the membrane filtration equipment of this invention.
[Drawing 2] Drawing 2 is the mimetic diagram of other examples of the membrane filtration equipment of this invention.
[Drawing 3] Drawing 3 is the mimetic diagram of the general example of the conventional processor.
[Description of Notations]
1 Filter
2 Bridge Wall
3 Raw Water Tub
4 Processing Tub
5 Diffuser
6 Perforated Plate
7 Adsorption Material Layer
8 Membrane Module
9 Overflow
10 Wastewater Weir
11 Circulating Pump
12 Suction Pump
13 Treated Water Tub
14 Drain Valve
20 Filter
21 Circulation Layer Equipment
22 Membrane Module
23 Filtration Section
24 Raw Water Feed Zone
25 Granular Adsorption Material
26 Suction Pump
27 Blois
28 Diffuser
29 Diaphragm
30 Raw Water Descent Section
31 Raw Water Rising Limb
32 Guide Plate
33 Treated Water Tub
34 Wastewater Weir

[Translation done.]

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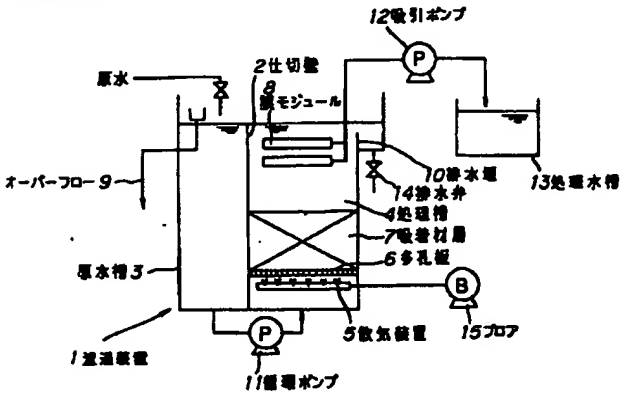
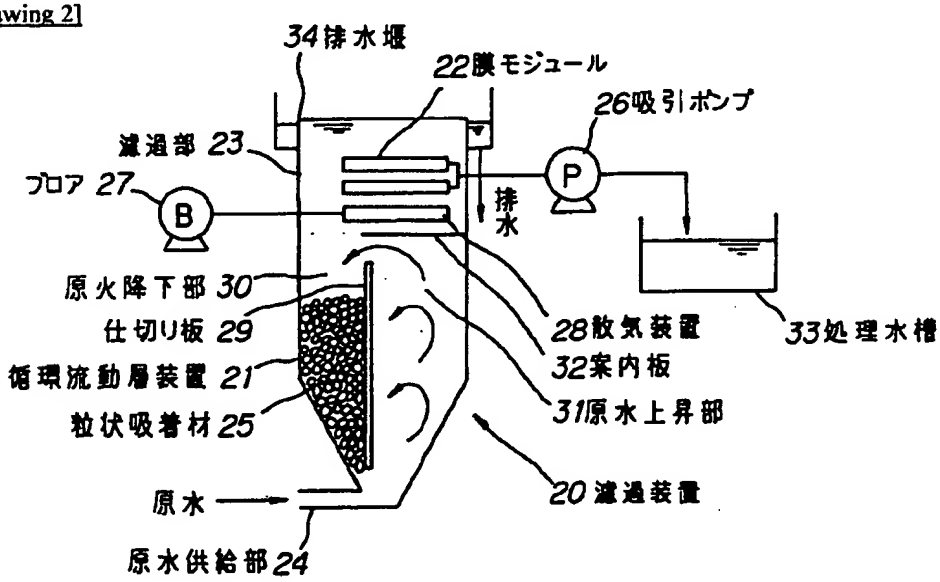
DRAWINGS

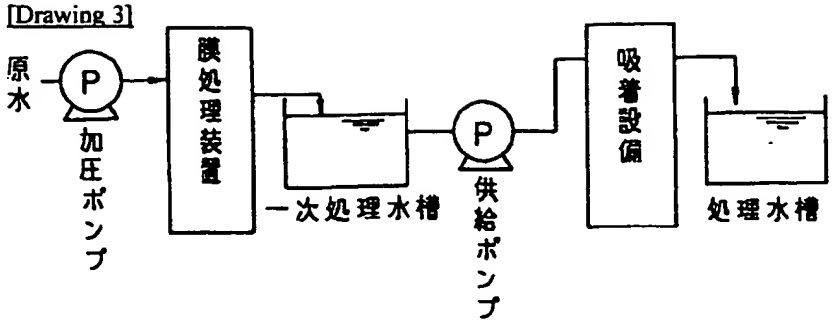
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]

[0011] Because a granular absorbent material layer is used for the fluid bed, there is an imbalance between the required water flow and the flow of membrane-processed water (normally, the water flow necessary to fluidize the granular absorbent material is greater than the membrane-processed water flow). Consequently, as a means for removing both suspended substances and dissolved substances in a single device and at the same time, it is useful to circulate the flow that is used for fluidization within the device. In terms of the method for circulating this raw water in the device, in addition to pumping the water with a pump, many methods can be used, such as stirring and the like.

[0012] Circulating the raw water within the processing device is useful not only for producing a fluid bed with the granular absorbent material layer, but also for increasing the contact time between the raw water and the absorbent material and increasing the efficiency with which the soluble substances are removed.

[0013] As suspended substances accumulated to a certain extent even in the fluidized granular absorbent material, the suspended substances are removed from the absorbent material by air washing. The air used for washing the absorbent material rises and serves to wash the membrane module which is disposed at the top of the processing device. In other words, by circulating the raw water, soluble substances are removed by absorption into the fluidized absorbent material, and some of the raw water is clarified by the membrane module to produce processed water.

[0014] It is also effective to make use of the circulating fluid bed device for removing soluble substances, described in the aforementioned JP-02-075304-A. The circulating fluid bed device described in JP-02-075304-A is such that a dividing plate provided in the center of processing tank divides the tank into a raw water upward flow section and a raw water downward flow section, the downward flow section being filled with granular absorbent material, and the raw water being supplied to the device from the bottom of the upward flow section, so as to circulate within the device and fluidize the granular absorbent material fill layer; a guide plate is provided at the top of the upward flow section and a separator unit is provided at the top of the downward flow section so as to promote granular absorbent material separation and prevent the granular absorbent material from passing beyond the guide plate and flowing out together with the processed water at the top of the device.

[0015] In this circulating fluid bed device, accumulation on the granular absorbent material layer of the suspended substances contained in the raw water is prevented by

the fluidization of the granular absorbent material, and separation and guidance of the granular absorbent material to the downward flow section is effectively performed so that, by providing an external pressure membrane module above the guide plate at the top of the upward flow section, and efficiently removing suspended material in the rising raw water with that membrane module, it is possible to remove both the suspended substances and the soluble substances at the same time in a single device.

[0016] Note that the membrane filter device of the present invention can also be used for processing sewage by the activated sludge method, and can be used in place of a sedimentation pond in activated sludge treatment processes, or can be expected to increase the efficiency of activated sludge treatment by causing activated sludge to be present within the filtration tank and causing a biological film to adhere to the absorbent material.

[0017]

[Embodiments] FIG. 1 illustrates an embodiment of the membrane filter device of the present invention. This embodiment serves to describe the present invention in concrete terms, but the present invention is not limited thereto.

[0018] (Embodiment 1) A filter device 1 is divided into a raw water tank 3 and a processing tank 4 by a dividing wall 2. An air diffusion device 5 for air washing is disposed at the bottommost part of the processing tank 4, and a perforated plate 6 for supporting granular absorbent material is disposed thereabove. The air diffusion device 5 is disposed below the perforated plate 6 in this [example] but it may also be [disposed] within the granular absorbent material layer 7. External pressure membrane modules 8 (this may be one module, but is normally a plurality of modules) are disposed above the granular absorbent material layer 7. In addition, a water discharge weir 10, lower than the dividing wall 2, is provided at a position higher than the external pressure membrane module 8, and an overflow 9 is provided at position higher than the dividing wall 2. The bottom of the raw water tank 3 and the bottom of the processing tank 4 communicate by way of a pipe, a circulation pump 11 being provided midway along the pipe so as to be able to circulate raw water between the two tanks.

[0019] The operation of the membrane filter device 1 is such that, first raw water is caused to flow into the raw water tank 3 of the membrane device 1, by pump pressure or natural downward flow. The circulation pump 11 is started and the raw water flows into the bottom of the processing tank 4 from the raw water tank 3; this results in an upward flow that fluidizes granular absorbent material in a granular absorbent material layer 7

and the raw water, which has been subjected to absorption processing, passes over the top of the dividing plate 2 and returns to the raw water tank 3. Thus, while the circulation pump 11 is running, the raw water circulates through the raw water tank 3 and the processing tank 4.

[0020] By starting a suction pump 12 that is connected to the external pressure membrane module 8 by a pipe, some of the circulating raw water is output to a processed water tank 13 as processed water, the suspended substances having been removed by the membrane. Normally, the raw water balance in the filter device 1 is maintained by adjusting the inflow of the raw water to match the flow of membrane-processed water. The flow of raw water circulating between the raw water tank 3 and the processing tank 4 is made greater than or equal to the flow necessary to fluidize the granular absorbent material. It is also possible to process [raw water] without circulation, if the flow of the membrane-processed water can be made to equal the flow of raw water necessary for fluidization.

[0021] When the granular absorbent material layer 7 and the external pressure membrane module 8 need to be washed, washing is performed by feeding washing air from a blower 15 that is connected to the air diffusion device 5 by a pipe. At this time, it is preferable that a discharge valve 14 disposed downstream of the water discharge weir 10 be opened and that the suction pump 12 for the membrane module 8 be stopped. The degree of opening of the discharge valve 14 should be adjusted so that the amount of water discharged matches the amount of raw water supplied.

[0022] The air that is diffused by the air diffusion device 5 eliminates suspended substances retained by the granular absorbent material layer 7 to the top of the granular absorbent material layer 7 and further air washes the membrane module 8 above the granular absorbent material layer 7. The washing discharge water passes over the washing discharge weir 10 and is discharged by the discharge valve 14. [Washing of] the membrane module 8 is normally performed by air washing, as described above, but in addition to this, processed water washing or the like may also be added.

[0023] (Embodiment 2) The membrane filter device of embodiment 1 was a device wherein a fluidized granular absorbent material layer was provided below the membrane module, but in place of this fluidized granular absorbent material layer, the circulating fluid bed device for removing soluble substances described in the aforementioned JP-02-075304-A can effectively be used.

[0024] Hereinafter a membrane filter device in which a circulating fluid bed device is

disposed below the membrane module is described using FIG. 2 as Embodiment 2. In FIG. 2, the membrane filter device 20 comprises a circulating fluid bed device 21 and an external pressure membrane module 22 disposed thereabove.

[0025] The circulating fluid bed device 21 is divided by a divider plate 29 into a raw water descending section 30, which is filled with granular absorbent material 25, and a raw water rising section 31. Raw water is supplied to the bottom of the device 20 from a raw water supply part 24 and rises in the raw water rising section 31. The granular absorbent material 25, with which the raw water descending part 30 is filled, is gradually supplied at a suitable rate from the bottom of the divider plate 29, which is cut away at this bottom part, to the raw water rising section 31, together with the raw water in a turbulent flow that rises and, in the course of this, the soluble components in the raw water are absorbed by the granular absorbent material 25.

[0026] The granular absorbent material 25, which rises together with the raw water, impinges against a guide plate 32 at the top of the raw water rising section 31 and is moved in the direction of the raw water descending section 30 and accumulated in the granular absorbent material 25 fill layer. Some of the raw water containing suspended substances is conveyed to a filtration unit 23 above the guide plate 32. Suction filtration is performed by way of an external pressure membrane module 22 disposed in this filtration part 23, using a suction pump 26, so as to remove the suspended substances from the raw water, and the processed water that has been filtered is sent to a processed water tank 33.

[0027] In the granular absorbent material 25 fill layer, there is a slight accumulation of the suspended substances contained in the raw water, but in the raw water rising section 31, [the absorbent material] rises together with the raw water in a turbulent flow, whereupon [the suspended substances] separate. Meanwhile, periodic washing of the external pressure membrane module 22 is necessary. In terms of the method of washing the membrane, this may be washed by any method, and various well-known methods are available such as a method wherein the accumulation of suspended substances is separated by vibrating the membrane by means of diffused air, a method wherein the accumulation is separated by direct vibration of the membrane from the exterior, or a method wherein washing is performed by causing processed water to pass from the interior face of the membrane to the exterior face thereof.

[0028] FIG. 2 shows an example of a washing method achieved by way of an air diffusion device. When washing, a blower 27 is started, air is diffused by way of an air

diffusion device 28, and the membrane module 22 is washed by the rising air bubbles so as to separate the accumulation. As for the method of evacuating the washing discharge water, the suction pump 26 for the external pressure membrane module 22 is stopped, or the suction rate is reduced, the raw water supply flow is increased to greater than the processed water flow, and this differential amount overflows a discharge weir 34 and flows out of the system as washing discharge water. [Thus] washing discharge water can be evacuated to the exterior of the tank by increasing the raw water supply flow.

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C02F	1/28	F	9262-4D		
	1/44	K	8014-4D		
	9/00	Z	6647-4D		

審査請求　未請求　請求項の数1(全 6 頁)

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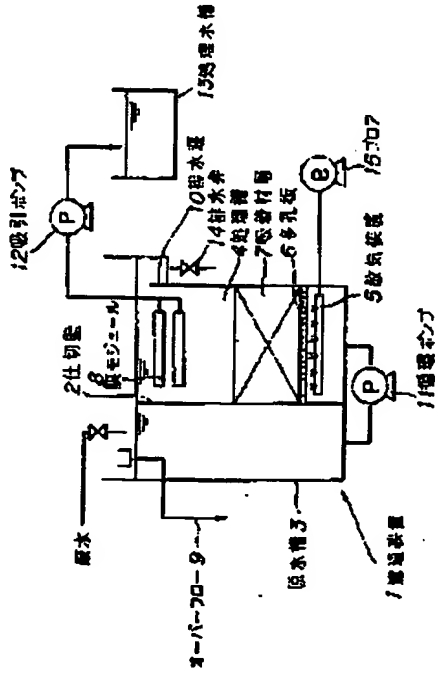
(54)【発明の名称】　膜濾過装置

(57)【要約】

【目的】　膜モジュールを配備した膜濾過装置による除濁，吸着設備による溶解性物質の除去を同一の装置内で行い，設備を簡略化すること。

【構成】　外圧型膜モジュールが配備されている膜濾過装置の下部に，原水中に溶解している溶解性物質を吸着する粒状吸着材を使用した吸着層を設けて懸濁物質および溶解性物質を同時に除去する。



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【特許請求の範囲】

【請求項１】　外圧型膜モジュールが配備されている膜濾過設備の下部に、原水中に溶解している溶解性物質を吸着する粒状吸着材を使用した吸着層を設けて懸濁物質および溶解性物質を同時に除去することを特徴とする膜濾過装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は河川水、湖沼水、し尿、下水、用水及び廃水などの原水に含まれる懸濁物を濾過するための膜濾過装置に関する。

【０００２】

【従来の技術】対象とする原水中には、ＳＳとして濾過で除去し易い無機物以外に、濾過装置内にスライムを生じさせ易い藻類、バクテリア（活性汚泥など）が多く含まれている。また、上記物質の他に色度、マンガン、かび臭などの異臭味、トリハロメタン前駆物質、微量有機物などの溶解性物質が含まれている。これらの原水を処理するためには、現在一般にＳＳ除去には〔凝集沈澱－濾過〕、〔加圧浮上－濾過〕などの方式で行い、溶解性物質に対してはＳＳ除去の工程と別に活性炭処理方式などで処理されている。

【０００３】上記した従来のＳＳ除去処理方式に比較すると、膜濾過装置によるＳＳ除去処理方式は、

１）溶解性物質以外の処理水の水質が非常によい。

２）無薬注で行える可能性がある。

３）将来の膜技術の進歩が望める。

など優れた点があり、実用化の技術開発が盛々行われている。しかし、緻密濾過膜、限外濾過膜では溶解性物質の除去が困難である。従って膜処理装置を使用してＳＳを除去処理する場合でも溶解性物質の除去のためには活性炭処理など別途の設備が必要となる。

【０００４】従って現状では、精密濾過膜または限外濾過膜を使用し、不溶性、溶解性物質の除去を行うためには図３に示すような工程になる。図において吸着設備としては、溶解性物質の除去のために粒状活性炭が一般的であるが、溶解マンガンの除去にはマンガン砂が必要になる。また、現状の工程では膜処理装置と吸着設備にそれぞれ洗浄設備が必要となる。

【０００５】溶解性物質の除去のために、特開平２－７５３０４号公報には、循環流動層装置が記載されている。同装置は粒状吸着材を用いてその粒状吸着材を原水と共に循環しながら、粒状吸着材の沈降速度よりも速い速度で原水と粒状吸着材の混合物を循環しながら溶解性物質を除去する優れた処理装置である。上記循環流動層装置は不溶解物の除去はできない。しかしながら、本装置は原水を循環して粒状吸着材層を流動層としているために、原水がＳＳ成分を含んでいても、固定吸着層の場合より懸濁物質の粒状吸着材層への堆積が少ないという特徴がある。

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【０００６】

【発明が解決しようとする課題】本発明の課題は、膜モジュールが配備されている膜濾過設備による除濁、吸着設備による溶解性物質の除去を同一の装置内で行い、設備を簡略化することにある。

【０００７】

【課題を解決するための手段】上記課題は、外圧型膜モジュールが配備されている膜濾過設備の下部に、原水中に溶解している溶解性物質を吸着する粒状吸着材を使用した吸着層を設けて懸濁物質および溶解性物質を同時に除去することを特徴とする膜濾過装置によって達成される。

【０００８】本発明の要点は、

①同一装置内で懸濁物質および溶解性物質を同時に除去するために、吸着材は粒状物として処理装置の下部に充填し充填層とする、原水は上向流として通水する。

②懸濁物質を含んだ原水を通水するために粒状吸着材層は固定層では粒状吸着材が懸濁物質によって閉塞を起こすため流動床とする。この粒状吸着材層で溶解性物質を吸着除去する。

③懸濁物質は粒状吸着材の流動床を通過するようにし、粒状吸着材層の上部に設置した膜モジュールで通過した懸濁物質を濾過によって除去する。

④粒状吸着材と膜モジュールの洗浄は同時に同一装置内で行う。ことにある。

【０００９】吸着材としては、粉状活性炭、マンガン砂など公知のものが使用できる。また、処理対象物質によっては複数の吸着材を混合使用してもよい。

【００１０】外圧式膜モジュールに使用する膜の材質は有機性膜でもセラミック膜でもよく、膜は濾過の際に分画される懸濁物の粒子サイズによって通常の濾過膜、精密濾過膜、あるいは限外濾過膜と分類される。通常の濾過膜は１μｍ以上の粒子を、精密濾過膜は０．０１～数μｍの粒子を濾過の対象とする。また、限外濾過膜は非常に微細なコロイド粒子あるいは高分子量分子を濾過の対象とする。

【００１１】粒状吸着材層を流動床とするために必要な水量と膜処理の水量が不釣合いになる（通常粒状吸着材を流動化させるに必要な水量が膜処理水量より大きい）。このため流動化用水量を装置内で循環させることは同一装置内で懸濁物質および溶解性物質を同時に除去するために有用な手段である。この原水を装置内に循環させる方法としてはポンプによる送水の他攪拌など多くの方法が取り得る。

【００１２】原水を処理装置内で循環させることは、粒状吸着材層を流動床とするための他、原水の吸着材との接触時間を増やし、溶解性物質の除去効率を増加させることにも役立つ。

【００１３】流動化させた粒状吸着材においても、ある程度の懸濁物質の堆積があるため空気洗浄によって懸濁

物質を吸着材から排除する。吸着材の洗浄に用いられた空気は上昇して、処理装置の上部に設置した膜モジュールの洗浄に用いられる。つまり、原水を循環させることにより流動吸着材に溶解性物質を吸着除去し、その原水の一部を膜モジュールで除濁して、処理水を得るのである。

【００１４】また、上記した特開平２－７５３０４号公報に記載の溶解性物質を除去するのための循環流動層装置を活用することも効果的である。特開平２－７５３０４号公報に記載の循環流動層装置は、処理槽を中央に設けた仕切り板で原水の上昇流部と下降流部とに仕切り、下降流部に粒状吸着材を充填し、原水を上昇流部の下から装置に供給し、装置内に循環させて粒状吸着材充填層を流動化し、上昇流部の上部に案内板を設け、下降流部の上方には分離部を設けて粒状吸着材の分離を促進し案内板を越えて装置上部に粒状吸着材が処理水と共に流出することを防止している。

【００１５】本循環流動層装置では、原水に含まれる懸濁物質の粒状吸着材層への堆積が粒状吸着材の流動化で防止され、粒状吸着材の下降流部への分離、案内が有効に行われるので、上昇流部の上部の案内板のさらに上に外圧型膜モジュールを配備して、その膜モジュールで上昇してきた原水中の懸濁物を効率よく除去することによって、同一装置内で懸濁物質および溶解性物質を同時に除去することが可能になる。

【００１６】なお、本発明の膜濾過装置は、活性汚泥法による汚水処理にも利用することができ、活性汚泥処理工程の沈殿池の代わりに利用したり、あるいは濾過槽内に活性汚泥を存在させたり、吸着材に生物膜を付着させたりして活性汚泥処理の効率化をはかることもできる。

【００１７】

【実施例】図１に本発明の膜濾過装置の実施例を示す。この実施例は本発明を具体的に説明するもので、本発明はこれに限定されるものではない。

【００１８】（実施例１）濾過装置１は仕切り壁２により原水槽３と処理槽４に分割されている。処理槽４の最下部には空気洗浄用の散気装置５を設置し、その上部に粒状吸着材を支持するための多孔板６が設置してある。散気装置５はここでは多孔板６の下部に設置したが、粒状吸着材層７の内部でも構わない。粒状吸着材層７の上部には外圧式膜モジュール８（１本でもよいが通常は複数）を設置する。その他、濾過装置１には外圧式膜モジュール８より高い位置で仕切り壁２より低く排水堰１０を、仕切り壁２より高い位置にオーバーフロー９が設けられる。原水槽３の下部と処理槽４の下部とは配管で連通され、配管途中に循環ポンプ１１を設置して両槽に原水を循環できるようになっている。

【００１９】膜濾過装置１の稼働は、先ず原水をポンプ圧送または自然流下で濾過装置１の原水槽３に流入する。循環ポンプ１１を起動して、原水を原水槽３から処理槽４の下部に流入し、上向流となって粒状吸着材層７の粒状吸着材を流動化させ、吸着処理された原水は仕切り板２を越えて原水槽３に戻る。かくて、循環ポンプ１１運転中は原水は原水槽３と処理槽４を循環することになる。

【００２０】外圧式膜モジュール８に配管で接続された吸引ポンプ１２を起動することにより、循環している原水の一部は膜により懸濁物質を除去され処理水として処理水槽１３に流出する。通常、膜処理水量に合わせて原水流入量を調節することにより、濾過装置１内での原水のバランスが崩れないようにする。原水槽３と処理槽４との間の循環原水量は粒状吸着材を流動化させるに必要な量以上とする。膜による処理水量が流動化させるに必要な原水量と同じにできる場合は、循環せずに処理することも可能である。

【００２１】粒状吸着材層７および外圧式膜モジュール８の洗浄が必要の時は、散気装置５に配管で接続されたブロア１５により洗浄空気を送って洗浄する。この時排水堰１０の下流に設置した排水弁１４を開とし、膜モジュール８用の吸引ポンプ１２は停止するのが好ましい。排水弁１４の開度は排水量が原水供給量にマッチする量に調節しておく。

【００２２】散気装置５より散気された空気は、流動化している粒状吸着材層７に抑留された懸濁物質を粒状吸着材層７の上部に排出し、さらに粒状吸着材層７の上にある膜モジュール８の空気洗浄も行う。洗浄排水は洗浄排水堰１０を越え排水弁１４より排水される。上記の通り通常膜モジュール８は空気洗浄にて行われるが、この他処理水洗浄などを追加しても構わない。

【００２３】（実施例２）実施例１の膜濾過装置は、膜モジュールの下部に流動化している粒状吸着材層を設けた装置であるが、この流動化している粒状吸着材層の代わりに上記した特開平２－７５３０４号公報に記載された溶解性物質の除去のための循環流動層装置が効果的に利用できる。

【００２４】膜モジュールの下部に循環流動層装置を設置した膜濾過装置を実施例２として以下に図２を用いて説明する。図２において、該膜濾過装置２０は循環流動層装置２１とその上部に設置された外圧式膜モジュール２２からなる。

【００２５】循環流動層装置２１は仕切り板２９によって粒状吸着材２５が充填されている原水降下部３０と原水上昇部３１とに仕切られている。原水は装置２０の底の原水供給部２４から供給され、原水上昇部３１を上昇する。原水降下部３０に充填された粒状吸着材２５は下部を切り欠かれている仕切り板２９の該下部から逐次つつ原水上昇部３１に供給され原水と共に撹乱流となって上昇しその途中で原水中の溶解性成分が粒状吸着材２５に吸着される。

【００２６】原水と共に上昇した粒状吸着材２５は原水

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上昇部３１の上部にある案内板３２に衝突して原水降下部３０の方向へ移動し、粒状吸着材２５の充填層に堆積する。原水はその一部が懸濁物質を含んだ状態で案内板３２の上部の濾過部２３に運ばれる。この濾過部２３に設置された外圧式膜モジュール２２で吸引ポンプ２６で吸引濾過して原水から懸濁物質が除去され、濾過した処理水は処理水槽３３に送水される。

【００２７】粒状吸着材２５の充填層では、原水中に含まれる懸濁物質が多少堆積するが、原水上昇部３１で原水と共に撹乱流となって上昇する際に剥離する。一方外圧式膜モジュール２２は定期的に洗浄する必要がある。膜の洗浄方式としては、散気による膜の振動により懸濁物質の堆積物を剥離させる方法、外部より直接膜を振動させて堆積物を剥離させる方法、処理水により膜の内面より外面へ通水して洗浄する方法など、種々の公知の方法があり、いずれの方法によって洗浄してもよい。

【００２８】図２には散気装置による洗浄法の例を示している。洗浄時、ブロア２７を起動し散気装置２８により散気し、上昇する気泡により膜モジュール２２が洗浄され、堆積物が剥離する。洗浄排水を槽外に排出する方法としては、外圧式膜モジュール２２の吸引ポンプ２６を停止するか、吸引量を減少して、処理水量より原水供給量を多くし、その差量が排水堰３４を越流し、洗浄排水として系外に流出する。原水供給量を多くして洗浄排水を槽外に排出することも可能である。

【００２９】

【発明の効果】本発明は原水中に含まれる懸濁物質および溶解性物質の除去が同一装置内で行え、また洗浄も可能であるため、設備が簡略になり、その設置面積も削減されるため設備費、稼働費および管理費などが大幅に軽減できる。

【図面の簡単な説明】

【図１】図１は本発明の膜濾過装置の一実施例の模式図である。

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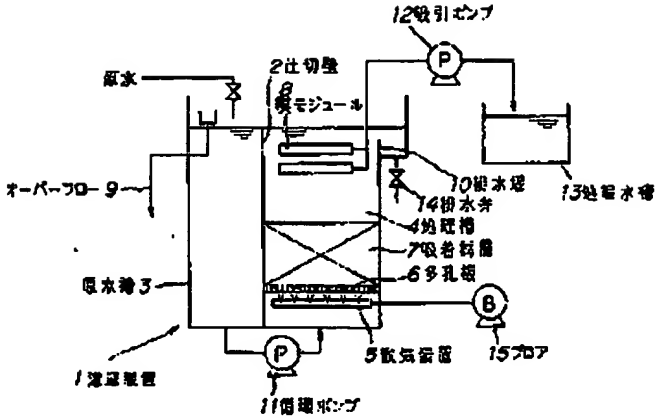
【図２】図２は本発明の膜濾過装置の他の実施例の模式図である。

【図３】図３は従来の処理装置の一般的な例の模式図である。

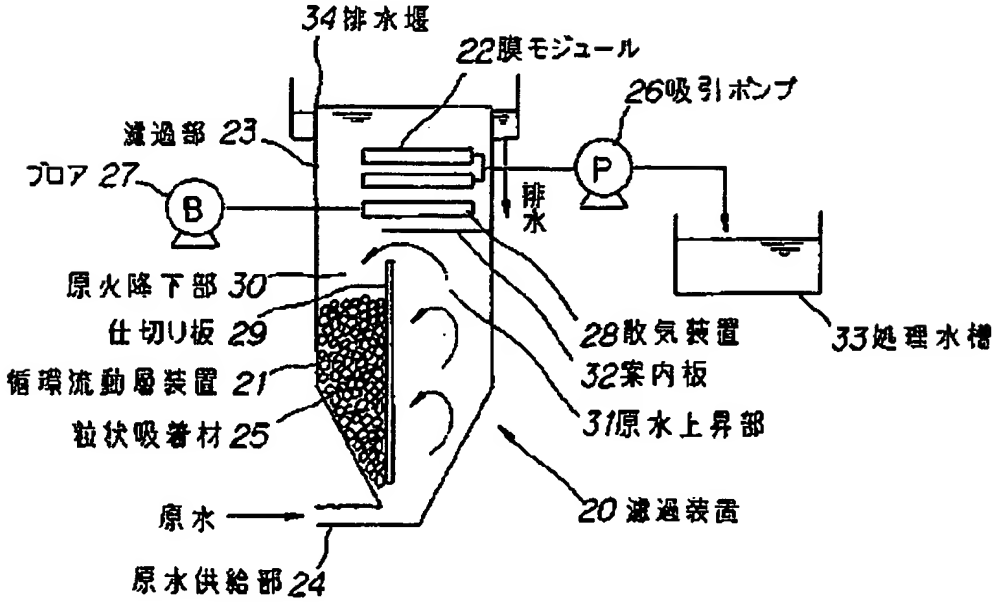
【符号の説明】

１　濾過装置
２　仕切壁
３　原水槽
４　処理槽
５　散気装置
６　多孔板
７　吸着材層
８　膜モジュール
９　オーバーフロー
１０　排水堰
１１　循環ポンプ
１２　吸引ポンプ
１３　処理水槽
１４　排水弁
２０　濾過装置
２１　循環流動層装置
２２　膜モジュール
２３　濾過部
２４　原水供給部
２５　粒状吸着材
２６　吸引ポンプ
２７　ブロア
２８　散気装置
２９　仕切り板
３０　原水降下部
３１　原水上昇部
３２　案内板
３３　処理水槽
３４　排水堰

【図1】


12吸引ポンプ
2仕切壁
8膜モジュール
原水
オーバーフロー 9
10排水堰
13処理水槽
14排水弁
4処理槽
7吸着材層
6多孔板
吸水槽3
5散気装置
15ブロア
1濾過装置
11循環ポンプ

【図2】


34排水堰
22膜モジュール
26吸引ポンプ
濾過部 23
ブロア 27
排水
原水降下部 30
仕切り板 29
循環流動層装置 21
粒状吸着材 25
28散気装置
32案内板
31原水上昇部
33処理水槽
20濾過装置
原水
原水供給部 24

【図3】